

CLAIMS

1. A heat exchanger for heat exchanging between an exhaust gas of an internal combustion engine and a cooling fluid, comprising:

5                   a plurality of flat exhaust gas passages through which said exhaust gas flows therein; and  
                      a plurality of corrugated fins arranged in each of said exhaust gas passage, each of said fin including a plurality of flat plate portions, a plurality of side wall portions, and a louvre disposed on the inner wall of said exhaust gas passage, wherein the louvre defining a surface thereof arranged along the exhaust gas flow direction, has a height from said inner wall increase towards upstream of said exhaust gas flow, and  
10                  said louvre is inclined with predetermined angle to a direction of said exhaust gas flow.

15                 2. A heat exchanger according to claim 1,  
                      wherein a plurality of said louvres are configured of a plurality of pairs of said louvres,  
20                 and a gap between each said louvres gradually increases towards downstream of said exhaust  
                      gas.

25                 3. A heat exchanger according to claim 2,  
                      wherein said corrugated fins each include a plurality of flat plate portions substantially parallel to the long diameter of said exhaust gas passage and a plurality of side wall portions formed at an angle to said flat plate portions as viewed from the direction of the exhaust gas flow, and

30                 wherein said louvres are each formed by cutting parts of each of said flat plate portions.

35                 4. A heat exchanger according to claim 3,  
                      wherein holes formed by cutting up parts of each of said flat plate portions are closed by defining members defining said exhaust gas passages.

5. A heat exchanger according to claim 2,  
                      wherein the upstream end portions of each

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of said sets of said louvres in said exhaust gas flow are arranged in a spaced relation with each other.

6. A heat exchanger according to claim 2,

wherein the distance ( $\delta$ ) between the downstream end of each of said louvres in said exhaust gas flow and said side wall portion is not less than 0.5 times as large as the maximum height (h) of said louvre but more than twice as large as the maximum height (h) of said louvre.

10 7. A heat exchanger according to claim 6,

wherein the distance ( $\delta$ ) between the downstream end of each of said louvres in said exhaust gas flow and said side wall portion is not less than 0.5 times as large as the maximum height (h) of said louvre but not more than the maximum height (h) of said louvre.

15 8. A heat exchanger according to claim 1,

wherein a plurality of said louvres are arranged in staggered fashion at angle to said exhaust gas flow along said exhaust gas flow.

20 9. A heat exchanger according to claim 8,

wherein the distance ( $\delta_2$ ) between the rear end portion of said louvre and said side wall portion adjacently arranged at an angle to said flat plate portion having said louvre is larger than the distance ( $\delta_1$ ) between the forward end portion of said louvre and said side wall portion adjacently arranged at an angle to said flat plate portion having said louvre.

25 10. A heat exchanger according to claim 8,

wherein, of a plurality of said louvres, the upstream louvre located upstream in said exhaust gas flow and the downstream louvre located downstream in said exhaust gas flow adjacently to said upstream louvre are arranged in such a manner that the forward end portion of said downstream louvre in said exhaust gas flow is located downstream of the rear end portion of said upstream louvre in said exhaust gas flow.

11. A heat exchanger according to claim 10,  
wherein said upstream louvre and said  
downstream louvre are arranged in superposed relation  
with each other as viewed from the direction of said  
5 exhaust gas flow.
12. A heat exchanger according to claim 10,  
wherein said upstream louvre and said  
downstream louvre are arranged in such a manner that the  
forward end portion of said upstream louvre and the rear  
10 end portion of said downstream louvre are displaced from  
each other as viewed from the direction of said exhaust  
gas flow.
13. A heat exchanger according to claim 10,  
wherein said upstream louvre and said  
15 downstream louvre are arranged in such a manner that the  
rear end portion of said upstream louvre and the forward  
end portion of said downstream louvre are displaced from  
each other as viewed from the direction of said exhaust  
gas flow.
14. A heat exchanger according to claim 10,  
wherein said upstream louvre and said  
downstream louvre are arranged in such a manner that the  
forward end portion of said upstream louvre and the rear  
25 end portion of said downstream louvre are substantially  
in superposed relation with each other as viewed from the  
direction of said exhaust gas flow.
15. A heat exchanger according to claim 10,  
wherein said upstream louvre and said  
30 downstream louvre are arranged in such a manner that the  
rear end portion of said upstream louvre and the forward  
end portion of said downstream louvre are substantially  
in a superposed relation with each other as viewed from  
the direction of said exhaust gas flow.
16. A heat exchanger according to claim 8,  
35 wherein the angle of the corner of the  
apex portion at the rear end portion of the louvre for  
which the distance from said flat plate portion is

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longest is not less than about 90°.

17. A heat exchanger according to claim 8,

wherein the contour of the apex portion at  
the rear end portion of the louvre for which the distance  
5 from said flat plate portion is longest is a smooth  
curve.

18. A heat exchanger according to claim 8,

wherein said louvres are formed  
substantially in a trapezoid in such a manner as to have  
10 a surface of which the distance from the flat plate  
portion increases progressively downstream in the exhaust  
gas flow.

19. A heat exchanger according to claim 8,

wherein the distance ( $\delta_2$ ) between the rear  
15 end portion of said louvre and said side wall portion is  
not less than 0.15 times as large as the maximum height  
( $h$ ) of said louvre but not more than twice as large as  
the maximum height ( $h$ ) of said louvre.

20. A heat exchanger according to claim 19,

wherein the distance ( $\delta_2$ ) between the rear  
end of each of said louvres in said exhaust gas passages  
and said side wall portion is not less than 0.15 times as  
large as the maximum height ( $h$ ) of said louvre but not  
more than the maximum height ( $h$ ) of said louvre.

21. A heat exchanger according to claim 10,

wherein the distance ( $\delta_1$ ) between the  
forward end portion of said louvre and said side wall  
portion is not less than 0.15 times as large as the  
maximum height ( $h$ ) of said louvre but not more than twice  
30 as large as the maximum height ( $h$ ) of said louvre.

22. A heat exchanger according to claim 21,

wherein the distance ( $\delta_1$ ) between the  
forward end portion of each of said louvres in said  
exhaust gas passages and said side wall portion is not  
35 less than 0.15 times as large as the maximum height ( $h$ )  
of said louvre but not more than the maximum height ( $h$ )

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of said louvre.

23. A heat exchanger according to claim 10,  
wherein the tilt angle ( $\theta$ ) of said louvre  
to said exhaust gas flow is not less than  $15^\circ$  but not  
more than  $45^\circ$ .

24. A heat exchanger according to claim 1,  
wherein each of those parts of the inner  
wall of said exhaust gas passage (tube) which corresponds  
to said flat plate portion of said corrugated fin is  
formed with a second protrusion projected inward of said  
exhaust gas passage.

25. A heat exchanger according to claim 24,  
wherein said second protrusions are each  
formed at a part facing the inside of said flat plate  
portion.

26. A heat exchanger according to claim 24,  
wherein said exhaust gas passage (tube)  
has a flat section, and a plurality of said second  
protrusions are arranged in staggered fashion along the  
short diameter of said tube.

27. A heat exchanger according to claim 24,  
wherein said second protrusions are formed  
on the longitudinal end portion of said tube.

28. A heat exchanger according to claim 24,  
wherein a plurality of said tubes are  
arranged in parallel to each other, and a header tank  
communicating with a plurality of said tubes is coupled  
by being fitted in a fitting portion at each of the  
longitudinal end portions of each of a plurality of said  
tubes, and

wherein the shape of said fitting portion  
at one longitudinal end portion of said tube and the  
shape of said fitting portion at the other longitudinal  
end portion of said tube are different from each other.

29. A heat exchanger according to claim 24,  
wherein a plurality of third protrusions  
projected inward of said tube for setting said fins in

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position with respect to said tube are formed on said tube.

30. A heat exchanger according to claim 1,  
wherein said exhaust gas passage includes  
5 a plurality of tubes arranged parallel to each other, and  
a header tank communicating with a plurality of said  
tubes is coupled by being fitted in a fitting portion at  
each of the longitudinal end portions of each of a  
plurality of said tubes, and

10 wherein the shape of said fitting portion  
at one longitudinal end portion of said tube and the  
shape of said fitting portion at the other longitudinal,  
end portion of each of said tubes are different from each  
other.

15 31. A heat exchanger according to claim 1,  
wherein the upstream end portion of said  
louvres in said exhaust gas flow is formed continuously  
from the bottom surface of said corrugated fin.

20 32. A heat exchanger according to claim 1,  
wherein the upstream end portion of said  
louvres in said exhaust gas flow has such a height (H)  
that the air flow riding over said louvre reaches the  
root of said louvre.

25 33. A heat exchanger for exchanging heat between  
the exhaust gas emitted from the internal combustion  
engine and a cooling fluid, comprising:

a flat exhaust gas passage through which  
said exhaust gas flows therein; and

30 a plurality of corrugated fins each  
arranged in said exhaust gas passage; and  
a plurality of louvres which are formed on  
the inner wall of said exhaust gas passage, inclined at a  
predetermined angle to said exhaust gas flow direction,  
and

35 wherein said louvres include a first part  
having a such a height as to form a swirl reaching the  
bottom surface of said fin, and a second part which is

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higher than said first part and located downstream of  
said first part in said exhaust gas flow.